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(54) IMPROVEMENTS IN OR RELATING TO OFFSET CYLINDERS

(71) We, KABUSHIKI KAISHA RICOH, a Japanese Body Corporate of 3—6, 1-Chome, Naka Magome, Ohta-Ku, Tokyo, 143 Japan,

do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to offset printing or duplicating machines.

According to the invention there is provided an offset printing or duplicating machine comprising an offset cylinder having a cylindrical surface of a polymer with a critical surface tension of not more than 25 dyne/cm, and an impression cylinder arranged to cooperate therewith.

Further according to the invention there is provided an offset printing or duplicating process comprising forming an ink image on the cylindrical surface of an offset cylinder and contacting the cylindrical surface of the offset cylinder with a substrate under pressure from an impression cylinder to form a printed or duplicated image thereon, the cylindrical surface of the offset cylinder having a critical surface tension of not more than 25 dyne/cm.

The surface of the offset cylinder of printing or duplicating machines in accordance with the invention is formed from a polymer having a critical surface tension of less than 25 dynes/cm. The polymer can be in the form, for example, of a coating or a film on various materials such as e.g. aluminium, copper, brass, iron or stainless steel, a hitherto proposed rubber-blanketed cylinder, or a cylinder of a synthetic resin such as a phenolic resin, an epoxy resin, an acrylic resin, a melamine resin, a polyester resin or an acrylonitrile/butadiene/styrene copolymer resin.

The use of offset cylinder cleaning devices with offset printing and duplicating machines in accordance with the present invention often can be avoided since the printing ink on the offset cylinder can easily be removed by passing as few, for example, as three or four sheets of paper between the offset cylinder and the impression cylinder used to provide good contact between the paper being printed and the offset cylinder.

The offset cylinders preferably have a layer or a film of the polymer on a surface thereof in order to provide the cylinder surface with the required surface tension.

Examples of suitable polymers and the critical surface tensions thereof, are shown in the following table:

	Critical surface tension γ_c (dyne/cm)
poly-dimethylsiloxane	20
polypropylene	23
fluorine-containing high molecular weight polymers, e.g.	
poly-(1,1-dihydropentadecafluorooctyl methacrylate)	11
polyhexafluoropropylene	16
tetrafluoroethylene/hexafluoropropylene copolymers	17
polytetrafluoroethylene	18
polytrifluoroethylene	22
poly-(vinylidene fluoride)	25
trifluorochloroethylene/vinylidene fluoride copolymers	25
hexafluoropropylene/vinylidene fluoride copolymers	25

For a fuller understanding of the invention, reference is made to the accompanying diagrammatic drawing in which:—

Figure 1 is a section through an offset printing or duplicating machine in accordance with the invention; and

[*Price 33p*]

Figure 2 illustrates the method of determining the critical surface tension of a polymer.

In Figure 1, an ink impression from a damped planographic surface of a plate cylinder 1 is made on a surface of a blanketed offset cylinder 2 having a surface of a polymer with a critical surface tension of not more than 25 dyne/cm. The impression is then transferred to a sheet of paper 3. The paper 3 is fed between the offset cylinder 2 and an impression cylinder 4 by a paper feed device (not shown).

The offset cylinder can thereafter be cleaned by passing three or four sheets of paper between the offset cylinder 2 and the impression cylinder 4 without plate cylinder 1 transferring ink to the offset cylinder 2. Alternatively, the offset cylinder 2 can be cleaned with cleaning liquid 5 supplied from a cleaning device 6 using cleaning roller 7 a cleaning device 6 using cleaning rollers 7 and 8. The cleaning liquid may be kerosene, toluene or xylene, containing trichloroethylene or cyclohexane. The cleaning device can, however, be omitted.

A method of determining the critical surface tension (γ_c) of a polymer, the method being particularly illustrated using a polypropylene film as an example, is illustrated in Figure 2. Drops of each of water, glycerol and triethanolamine were formed on the surface of the polypropylene film. The angles of contact θ_1, θ_2 and θ_3 respectively, as shown in Figure 2(a), Figure 2(b) and Figure 2(c), were measured and the values of $\cos\theta_1$, $\cos\theta_2$ and $\cos\theta_3$ were obtained.

The angles θ_1, θ_2 and θ_3, and $\cos\theta_1$, $\cos\theta_2$ and $\cos\theta_3$, were as follows:

$\theta_1=82°$	$\cos\theta_1=0.14$
$\theta_2=75°$	$\cos\theta_2=0.26$
$\theta_3=59°$	$\cos\theta_3=0.51$

The surface tensions of water, glycerol and triethanolamine are as follows:

water	72 dyne/cm
glycerin	65 dyne/cm
triethanolamine ...	50 dyne/cm

As shown in Figure 2(d), points A, B and C were obtained by plotting the surface tension values as abscissa against the values of $\cos\theta$ as ordinate.

Projecting the line joining the points A, B and C gave a point D for $\cos\theta$ being unity, and the corresponding value of surface tension is the critical surface tension of the polypropylene.

The critical surface tensions of the other polymers can be measured by the same method. However, where the polymer used to form the surface of the cylinder is deposited from solution in an organic solvent, the critical surface tension can be estimated using a layer of the polymer produced by applying a solution of the polymer on to a solid surface and then evaporating the solvent.

The layer or the film of the polymer having a critical surface tension of not more than 25 dyne/cm can be formed on the surface of a cylinder, for example in the following manner:

(1) by applying a solution of the polymer in an organic solvent to the surface of the cylinder and then evaporating the solvent, or
(2) by winding a film of an insoluble polymer around the cylinder.

We have found that more than 80% of printing ink on an offset cylinder of a machine in accordance with the invention can be transferred to paper on which it is to be printed.

Printing ink on the offset cylinders can generally be easily removed, for example by passing only a few sheets of paper between the offset cylinder and the impression cylinder used to press the paper being printed against the offset cylinder. Washing of the offset cylinder using a cleaning liquid on completion of the printing operation may be avoided.

Transferring printing ink from a plate cylinder on to an offset cylinder of a machine in accordance with the present invention is generally less efficient than with hitherto proposed rubber-blanketed offset cylinders. However, since the transfer of printing ink from offset cylinders of machines in accordance with the invention to a sheet of paper is generally greater than with hitherto proposed rubber-blanketed offset cylinders, printed matter having high density can be obtained.

The following Examples are given by way of illustration only. Various offset cylinders were produced and used in an offset printing machine sold by K. K. Ricoh under the trade mark "RICOH OFFSET 1000" instead of the normal offset cylinder and without the normal cleaning device being used.

The offset printing ink used was prepared from the following ingredients:

	Parts by weight
carbon black	3.8
alkyd resin	5.0
tall oil	5.6
xylene	5.4
cobalt naphthenate	0.2
polybutene (sold by Nippon Petrochemicals Co. Ltd. under the trade mark of "LV-10") ...	5.4

	Parts by weight
propylene glycol alginate (2% aqueous solution)	50.0
a poly-(vinyl methyl ether/maleic anhydride copolymer)	0.5
liquid paraffin	1.0
mono-ethanolamine	0.4
water	75.0

EXAMPLE 1

A solution was prepared from the following ingredients:

	Parts by weight
poly-dimethylsiloxane (sold by Shinetsu Silicone Co. Ltd. under the trade mark "KE42TS") ...	10
n-heptane	10

This solution was applied to an offset cylinder (a nitrile/butadiene rubber-blanketed cylinder) and then dried for 48 hours at a temperature of 50°C and a relative humidity of 60%. A layer of poly-dimethylsiloxane having a γ_c of 20 dyne/cm was formed on the surface of the offset cylinder. Using this offset cylinder in a printing process, printed matter having high density could be obtained. When the printing process was complete, the printing plate (or master sheet) was removed and sheets of paper were passed between the offset cylinder and the impression cylinder. Three sheets of paper were sufficient to clean the offset cylinder.

EXAMPLE 2

The same procedure was used as in Example 1 except that the poly-dimethylsiloxane sold by Shinetsu Silicone Co. Ltd. under the trade mark "KE45S-RTV" was used instead of the "KE42TS" poly-dimethylsiloxane.

A layer of poly-dimethylsiloxane having a γ_c of 20 dyne/cm was formed on the surface of the offset cylinder.

Similar results to those of Example 1 were obtained.

EXAMPLE 3

A film of tetrafluoroethylene/hexafluoropropylene copolymer (sold by E. I. du Pont de Nemours & Co. Inc. under the trade mark of "TEFLON FEP"), having a thickness of 0.5 mm and a γ_c of 17 dyne/cm, was wound around an offset cylinder, instead of forming a layer of poly-dimethylsiloxane on the surface of the offset cylinder as in Examples 1 and 2. Using such an offset cylinder, similar results to those described in Example 1 were obtained, namely the offset cylinder could be cleaned using three sheets of paper after printing had been finished.

EXAMPLE 4

A film of propylene, having a thickness of 0.2 mm and a γ_c of 23 dyne/cm, was used instead of the "TEFLON FEP" used in Example 3.

The offset cylinder could be cleaned using four sheets of paper after printing had been finished.

EXAMPLE 5

A film of polyvinylidene fluoride, having a thickness of 0.3 mm and a γ_c of 25 dyne/cm, was wound around an offset cylinder. Using this offset cylinder, similar results to those of Example 4 were obtained.

WHAT WE CLAIM IS:—

1. An offset printing or duplicating machine comprising an offset cylinder having a cylindrical surface of a polymer with a critical surface tension of not more than 25 dyne/cm, and an impression cylinder arranged to cooperate therewith.

2. A printing or duplicating machine according to claim 1, wherein the said polymer comprises a fluorine-containing polymer.

3. A printing or duplicating machine according to claim 2, wherein the said fluorine-containing polymer comprises poly-(1,1-dihydropentadecafluorooctyl methacrylate), polyhexafluoropropylene, tetrafluoroethylene/hexafluoropropylene copolymers, polytetrafluoroethylene, polytrifluoroethylene, poly-(vinylidene fluoride), trifluorochloroethylene/vinylidene fluoride copolymers or hexafluoropropylene/vinylidene fluoride copolymers.

4. A printing or duplicating machine according to claim 1, wherein the said polymer comprises poly-dimethylsiloxane.

5. A printing or duplicating machine according to claim 1, wherein the said polymer comprises polypropylene.

6. An offset printing or duplicating machine substantially as herein described with reference to Figure 1 of the accompanying drawings.

7. An offset printing or duplicating machine, substantially as herein described with reference to any of the Examples.

8. An offset printing or duplicating process comprising forming an ink image on the cylindrical surface of an offset cylinder and contacting the cylindrical surface of the offset cylinder with a substrate under pressure from an impression cylinder to form a printed or duplicated image thereon, the cylindrical surface of the offset cylinder having a critical surface tension of not more than 25 dyne/cm.

9. A process according to claim 8 effected using an offset printing or duplicating machine as claimed in any of claims 2 to 7.

10. Prints and duplicates when produced by a process according to claim 8 or 9 using a printing or duplicating machine as claimed in any of claims 1 to 7.

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1390833 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG. 1

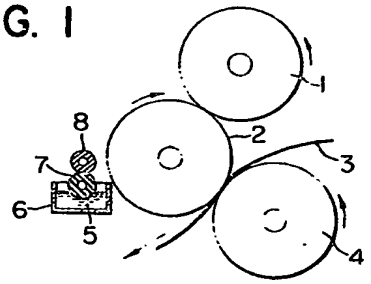

FIG. 2